United States Army Logistics Transformation Agency

The Art of the Possible – Science & Technology in a World of Change

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Logistics Transformation Agency
www.lta.army.mil

"We're going to have to change some of the things that made us the best Army in the world. Our values are sacrosanct… ... everything else is on the table."

Army Chief of Staff
General Peter J. Schoomaker

Final Thoughts Up Front

- Change is inevitable and occurring faster than ever before and at an ever increasing rate
- To survive, organizations must embrace and internalize change in their cultures.
- The most successful survivors will be those who are most agile, receptive, adaptive and responsive.
- The leaders among the successful survivors will be those who foresee and prepare for change, and act decisively to exploit their brief technological advantage.

Change Management Overview

Change Management, Defined

1. The task of managing change
   - Reactive
   - Proactive
2. Program management of scope and objectives that lead to realization of a vision
3. Necessary actions to ensure complex change gets the right results in the right timeframe at the right costs

How are some organizations able to change successfully, systematically and repeatedly?

- Managers and workers have learned change as a normal organizational process
- Managers see change as inevitable and even desirable
- Managers have the tools and discipline needed to make effective change possible
- Managers and employees see change as a regular and necessary part of their business.

Source: Institute for Change Leadership (Holland & Davis, LLC)

Why Change Efforts Fail

- Typically, at the start of a transformation, about 70% of the people are either fighting it or are indifferent to it
- Change solution not aligned to key business objectives (i.e. the Vision), strategically and/or operationally
- Changes (people, process and technology) are not managed from an integrated perspective and interdependencies are not addressed
- People (from End User upward) are not actively engaged and informed
- Considerable energy is expended in attempting to “get people up to speed” after the fact

Change Issues to Consider

- Organizations often fail to realize the level of effort, work, dedication, and leadership required to successfully respond to change
- Major change requires significant modification of established patterns of behavior and expectations
- Mid-level Managers can become the “Black Hole.” They are the key to a successful implementation but, they are the hardest to energize

Change Issues to Consider, cont.

Reasons For Reluctance

- Unwillingness to change from status quo (safety)
- Difficulty in disconnecting from the past (habit)
- Uncertainty of what the future holds (unknown)
- Fear of Loss:
  - Economic Security
  - Friendships
  - Self-Respect
  - Self-Fulfillment

Behavior Factors

- Priorities
- Resources
- Attitude
- Perceptions
  - Yours
  - Theirs

Potential Change Factors

- New roles and responsibilities
- New Skills
- Altered communication patterns
- Altered work relationships
- New work schedules
- New work approaches (individual vs. team)
- Redefined points of influence and authority
- New management approaches (coach vs. supervise)

Effective Change Tools

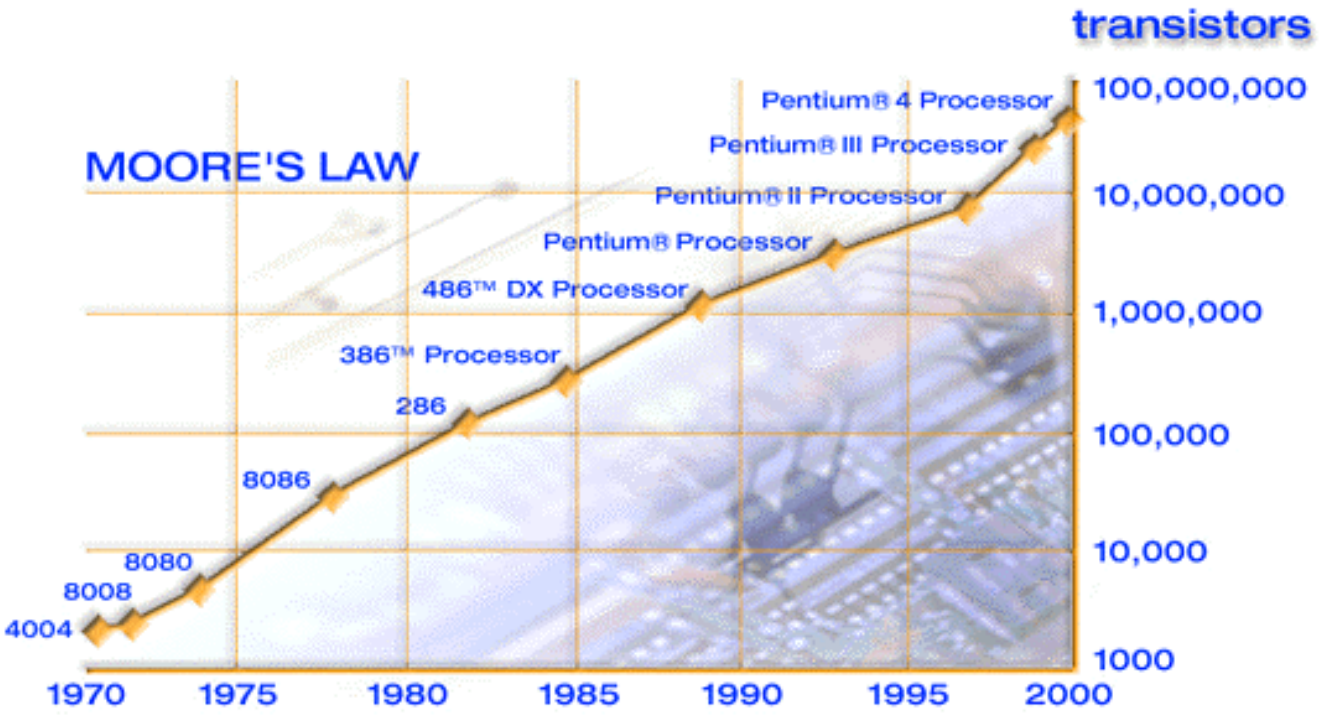
- Identifying the Stakeholders – consider all comers
  - Not all Stakeholders are created equal
  - Consider their role in the enterprise (drives perspective)
  - What are their mission drivers (i.e. motivators)
- Establish a process for managing Stakeholder Issues
  - Spell out how they will be tracked; monitored, closed
  - Build a methodology on how issues will be worked
  - Ensure ownership is clearly established
- Line Up Stakeholders
  - Give sponsorship briefing to Senior Leader
  - Follow up with Sponsorship briefing to Deputies/Directors
- Mobilize Management Team
  - Develop objectives and action plans
  - Provide requisite orientation/education
  - Define roles/responsibilities
  - Establish process ownership
  - Determine operating norms
- Develop Site Communications Plan
  - Implements Project Communications Plan
  - What, when, who & how

Demonstrated long term, unrelenting commitment by the Leadership is an imperative!

Technical Innovations

The Nature of Technological Innovation

Moore's Law, formulated by Gordon Moore of Intel Corporation, says (roughly) that chip density doubles every eighteen months. This means that memory sizes, processor power, etc. all follow the same curve. Most experts, including Moore himself, expect Moore's Law to hold for at least another two decades. Beyond transistors, other technologies following Moore's Law include nanotechnology, photonic band gap technologies, and metamaterials.



Intel Corporation (http://www.intel.com/research/silicon/mooreslaw.htm)

The Paradox of Technological Innovation

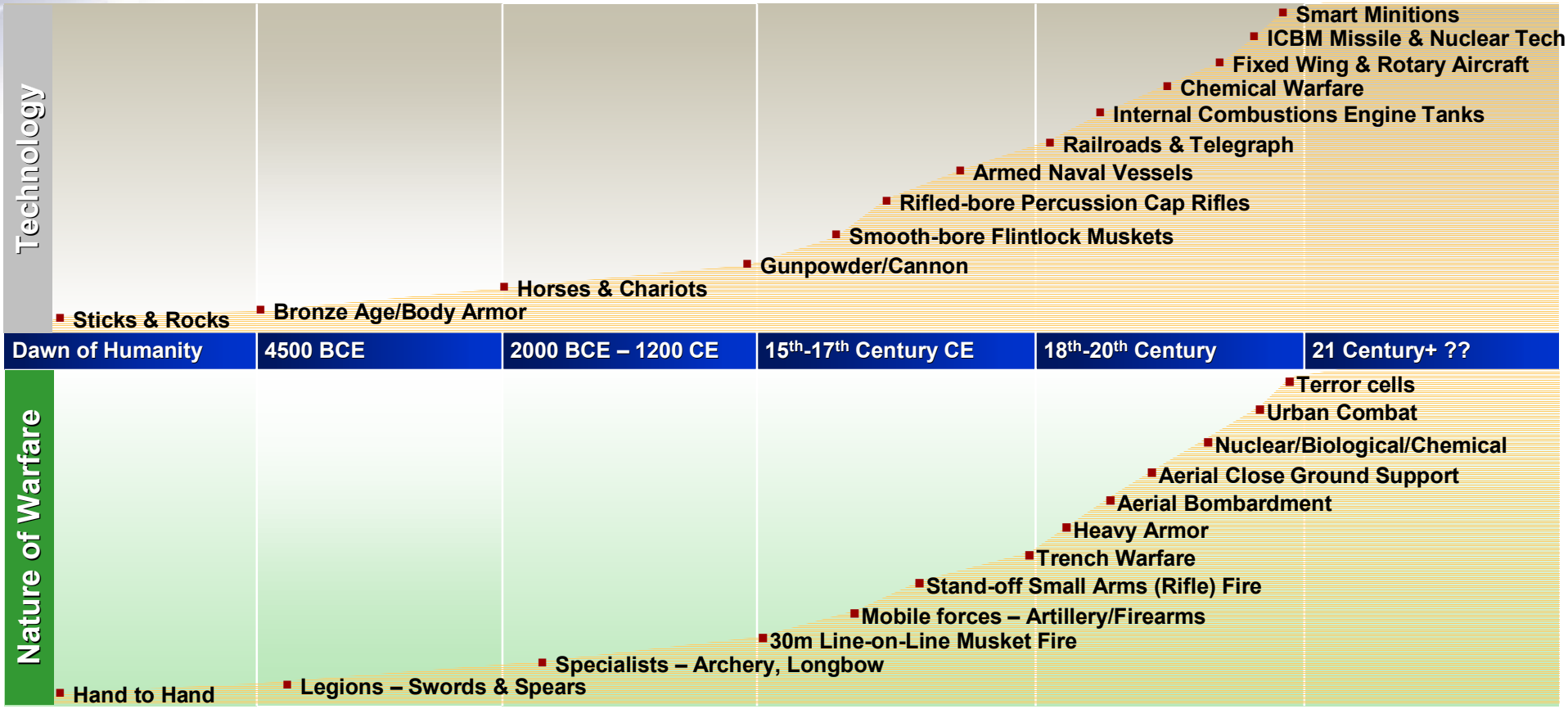
Innovation creates progress, reduces or eliminates manual or repetitive tasks, and provides convenience and a better quality of life.

HOWEVER…

- **Innovations provide us with devices or tools that we never needed before, yet we can no longer live without**
- **Innovations are a mixed blessing, as they create new problems, requiring new and elaborate rules to control their use**
- **Innovation does not recognize cultural and political realities.**

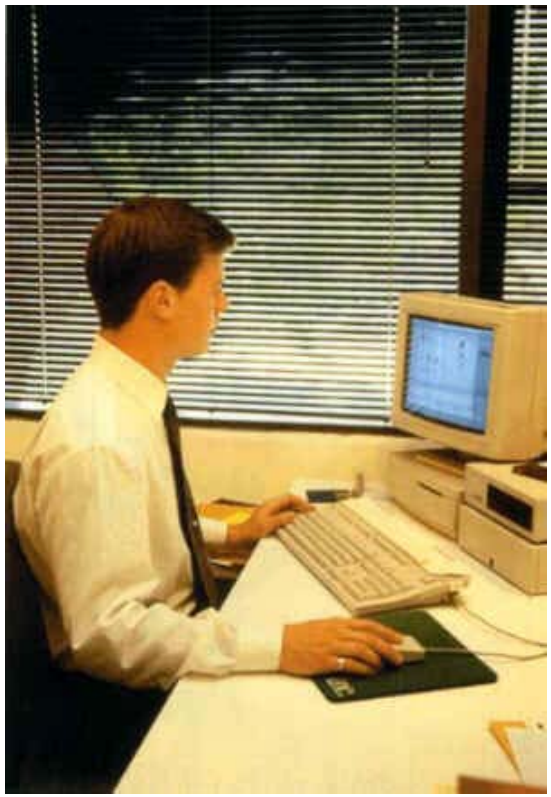
Change in Military Environment

Historically, New Technology and the Nature of Warfare drive the need for Logistics Adaptation and Transformation



Who Knew?

- E-Mail (Ray Tomlinson of ARPANET sent the World's first e-mail in 1971)
- The Internet and the Web (by 1993, available and growing in popularity)
  - Banking on line
  - E-bay
  - Electronic Airline Tickets
  - Throw Away Technology
- Wireless Technology
  - Cellular phones
  - Wireless computers and PDAs



Who Knew?

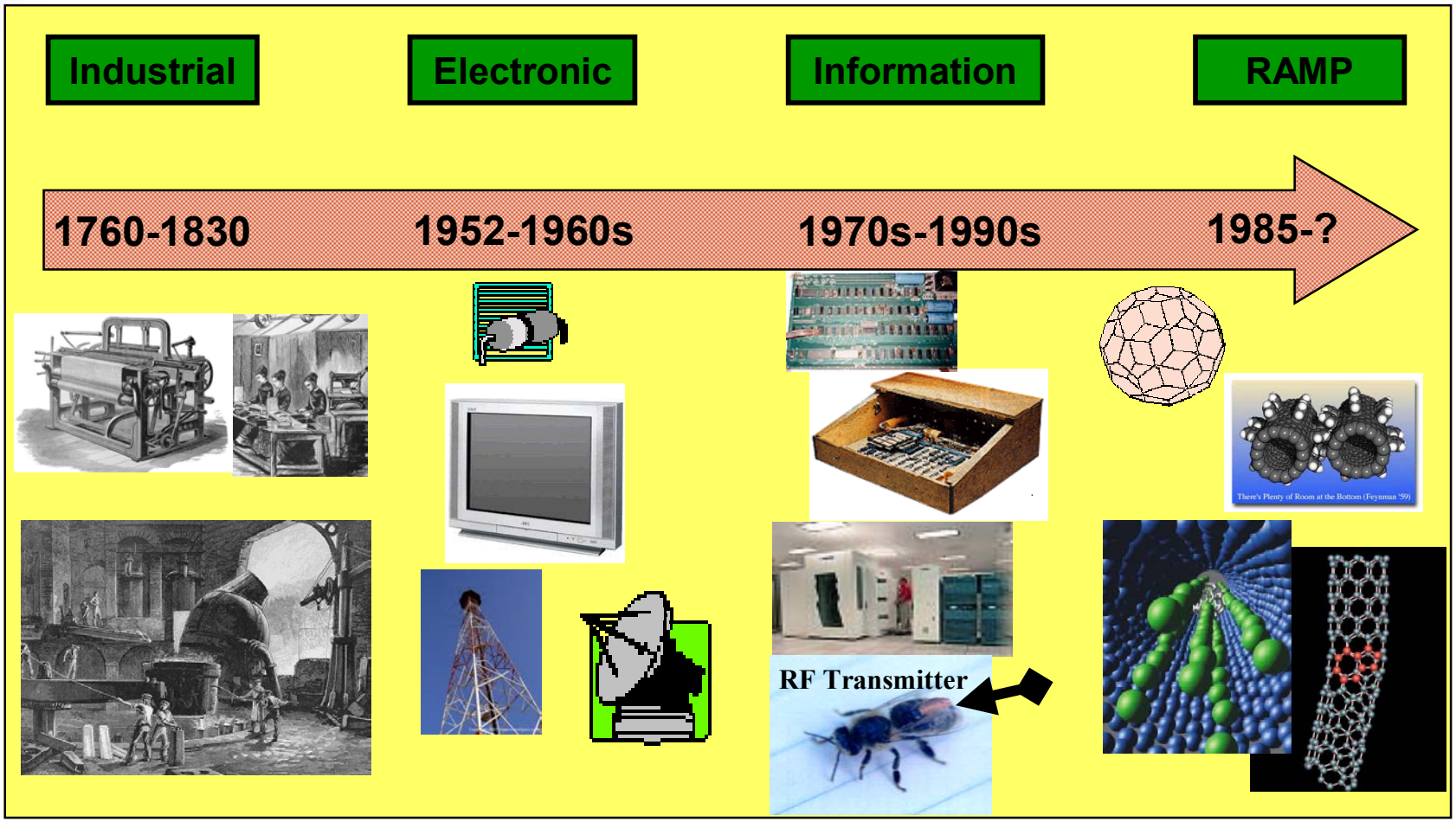
- In 1886 Heinrich Hertz created Hertzian Waves
  - The first radio waves as we know them today but precursor to microwaves
- In 1917 Sir Robert Watson-Watt began experiments with microwaves
  - 1917 trying to discover a way to find thunderstorms
  - April 1935 filed a British patent for "radar" to detect aircraft
  - 1939 first combat use of microwaves (radar) to detect aircraft
- Microwaves for Cooking
  - 1954 Raytheon introduced the first Amana "Radar" Range for cooking food, commercial application only as it was 6 feet high weighing 750 lbs.and operated at 1600 watts
  - 1959 Raytheon introduced domestic "radar" range, known today as a microwave oven
- Microwaves for Communications
  - 1931 Marconi experiments in microwave communications
  - 1947 microwave communications demonstrated between New York and Philadelphia
  - 1963 Microwave Communications Incorporated (MCI)microwaves first used for communications
  - 1978 prototype cell phone system of 2000 subscribers was demonstrated in Chicago
- Lesson learned: One scientist's search for thunderstorms resulted in a combat radar system, home cooking appliance and a wireless global communications system being exploited by our military today

History of Science and Technology

- People naturally comfortable with the Status Quo
- Uneasiness with Unknown or Unfamiliar
- Transistors & Integrated Circuits
  - Unknown prior to 1950 and 1952 respectively
  - Many *practical applications* today and the beginning of the Electronics Revolution
    - Transistor Radios, household appliances, computers
- Quantum Mechanics
  - *only* a theory in 1970s
  - Many *practical applications* today e.g., Lasers
    - Bar codes read by lasers to track logistics assets
    - Computer CDs read & written to by lasers to store and retrieve logistic information
- If it sounds strange today it will in all probability be Reality Tomorrow
  - Molecular Memory, Photon and Quantum Well Processing, Molecular Self Assembly, etc

History of Scientific Revolutions

- The Revolution in Atoms, Molecules & Photons – "RAMP" is the ability to see, manipulate, and build at the the sub-atomic, atomic and molecular level



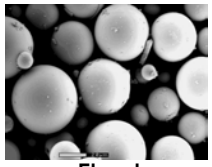
The Scale of Things – Nanometers & More

Things Natural

Dust mite
200 µm

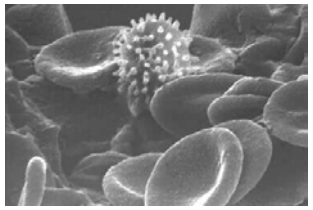
Ant
~ 5 mm

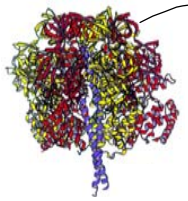
Human hair
~ 10-50 µm wide



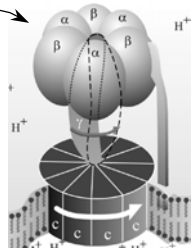
Fly ash
~ 10-20 µm

Red blood cells with white cell
~ 2-5 µm



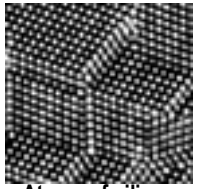


~10 nm diameter

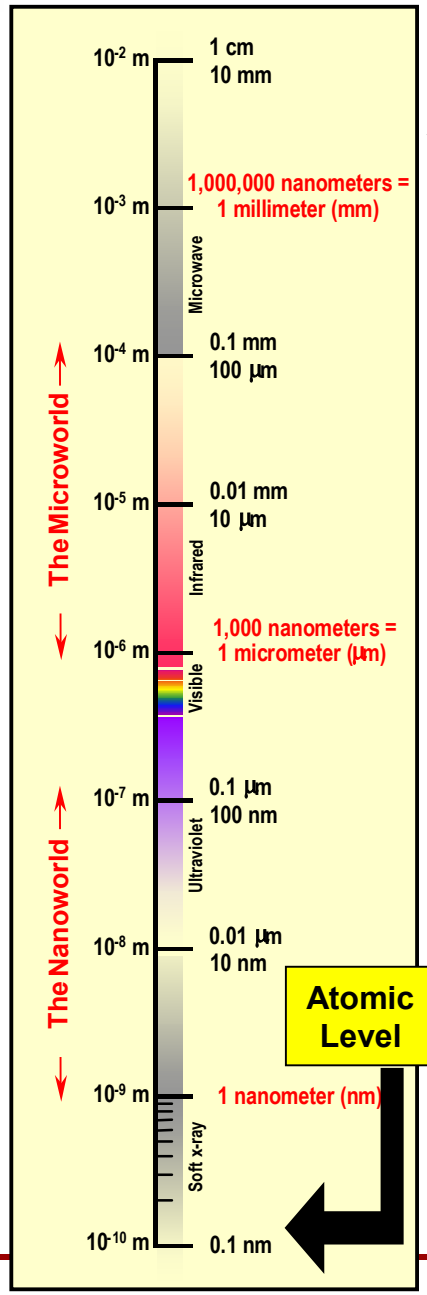


ATP synthase

DNA
~2-1/2 nm diameter



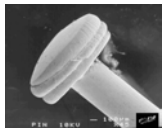
Atoms of silicon
spacing ~tenths of nm



Multiple Molecules

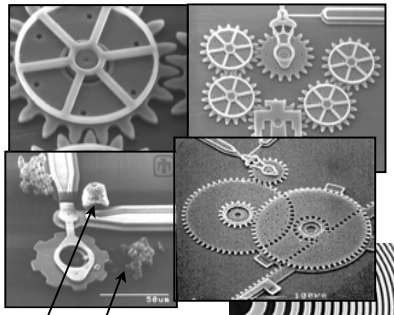
Atomic Level

Things Manmade

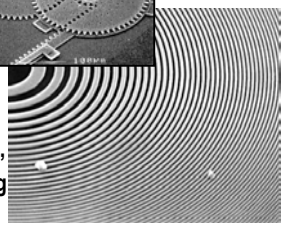


Head of a pin
1-2 mm

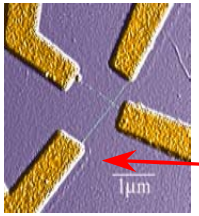
MicroElectroMechanical devices
10 -100 µm wide



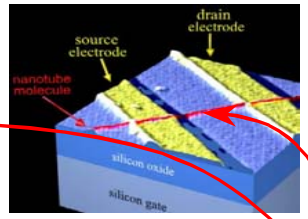
Red blood cells
Pollen grain



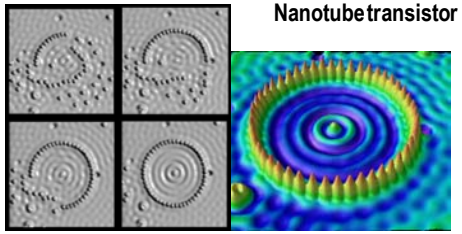
Zone plate x ray "lens"
Outermost ring spacing
~35 nm



Nanotube electrode

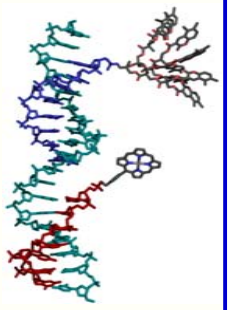


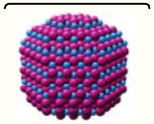
Nanotube transistor



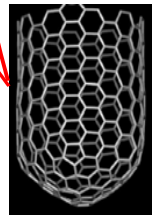
Quantum corral of 48 iron atoms on copper surface positioned one at a time with an STM tip
Corral diameter 14 nm

21st Century Challenge





Combine nanoscale building blocks to make novel functional devices, e.g., a photosynthetic reaction center with integral semiconductor storage



Carbon nanotube
~2 nm diameter

Comparison Computer - Brain of an Insect

Cray YMP/8

8 processors
~ 10^6 transputers
~ 6 x 10^{-9} sec switch time
~ 10^{10} instructions/sec
~ 10^3 kg mass
~ 10^5 W power consumption

Programming in HL languages, numerical, and AI

Brain of a Bee

~ 10^6 neurons
~ 10^9 synapses
~ 10^{-3} sec switch time
~ 10^{12} operations/sec
~ 10^{-5} kg mass
~ 10^{-6} W power consumption

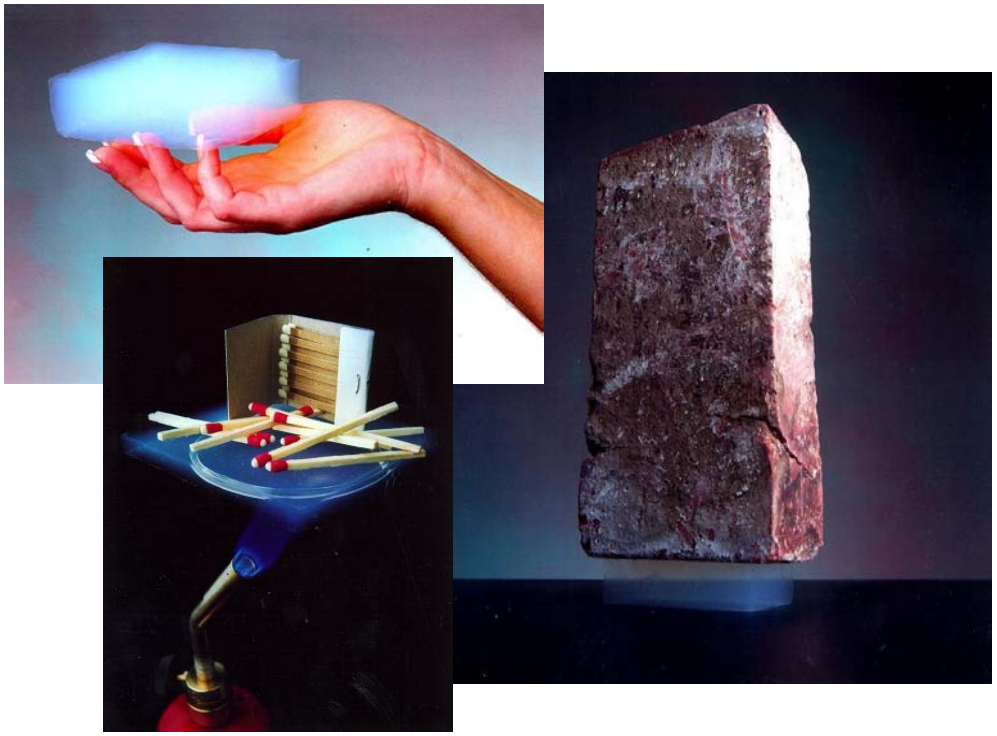
Specialized in: pattern recognition, navigation, movement control, coordination, social behavior, and communication

To at least perform a small step towards a technical implementation of biological intelligence, new computational techniques must be considered and introduced.

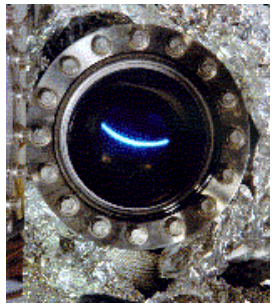
BGT -- Bodenseewerk Gerätetechnik GmbH

Exploiting RAMP (Revolution in Atoms Molecules and Photons)

- Disintegrating Meteors as Surrogate LEO "Satellites" for Communications to Connect the Logistician
  - Extremely important when G4 is having to pay Tens-of-Millions of dollars to supplement satellite connectivity
  - Meteors are FREE
- Aerogel material
  - Transparent
  - Heat Resistant
  - Holds 4000 times its own weight without deformation
  - 99.38% Air
  - Extremely important when FCS is counting ounces to obtain vehicle weight goal



Exploiting RAMP for Communications



- **Wireless Communications**
  - **Photonic Based Terahertz Lightbeams (Brookhaven National Lab)**
    - **600,000-fold increase in real data rates**
    - ***"It is dangerous to put limits on wireless."* Gugliemo Marconi 1932**
    - **Instantaneous situational understanding – integration of ALL data types**
    - **Drive by wireless could replace drive/fly by wire ~ reliability, wt reduction, reduced fuel consumption**
  - **Terahertz Operational Reachback ~ THOR (DARPA)**
    - **Lightweight, high-speed optical communications networks for mobile-expeditionary forces that do not require fiber-optic cables**
    - **Provides orders of magnitudes more useable frequencies within any given bandwidth**
    - ***Sufficient bandwidth for dedicated Logistics' frequencies***
  - **3-Dimensional nanophotonic devices that use spin charged photons**
    - **Fundamentally changes electronics as we know it ~ *Spintronics***
      - **More reliable**
      - **Greater Capacity**
      - **Smaller medium in which to operate**
    - **Design more reliable materials**
    - **Next generation embedded memory**
    - **More reliable parts – reduced thermal buildup**

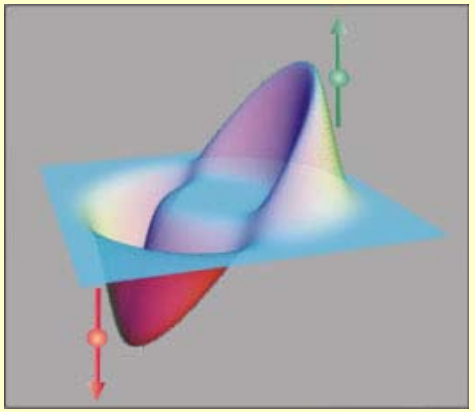
THz Frequency Projections

2010 @ 10-fold increase
2015 @ 50-fold increase
2020 @ 100-fold increase

Spintronics

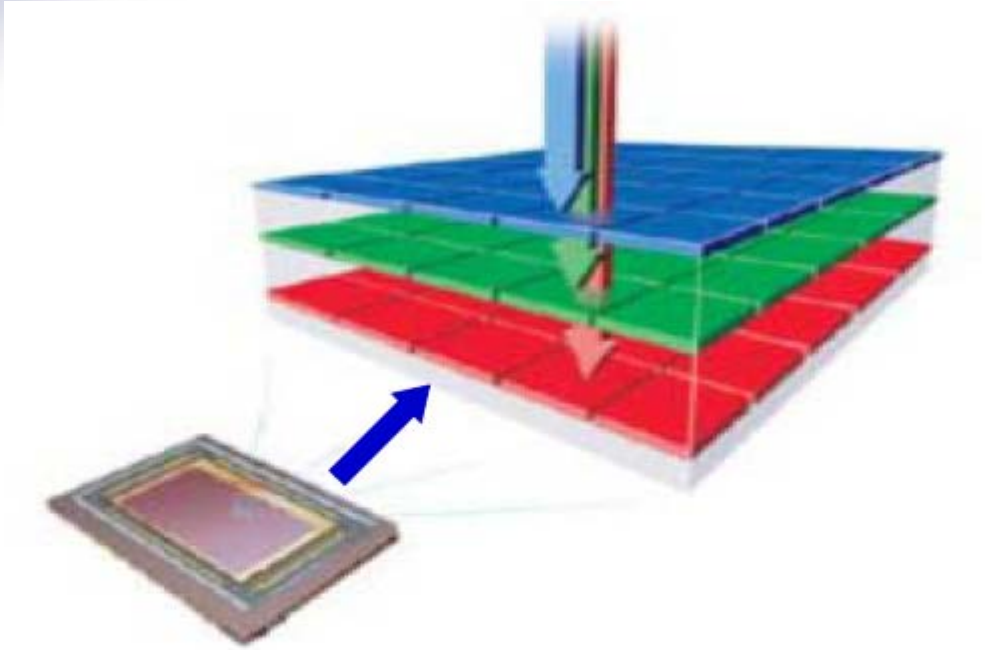
- Spintonics – using the spin of quantum mechanical particles to carry signals and process information in new ways
- In contrast – electronics ➡ using the charge of electrons and holes to carry signals and process information
- Why? – to gain new functionality, and to minimize size and power dissipation
- Examples –
  - magnetoresistive random access memory (MRAM) ➡ nonvolatile memory
  - spin-based devices (such as optical switches) ➡ higher speed and new functionality
  - quantum bit based devices ➡ quantum computation

With some quantum trickery, laser light makes spin-up electrons (green) flow one way and spin-down electrons (red) flow the other inside a semiconductor. The opposing flows produce a pure spin current without an electrical current.

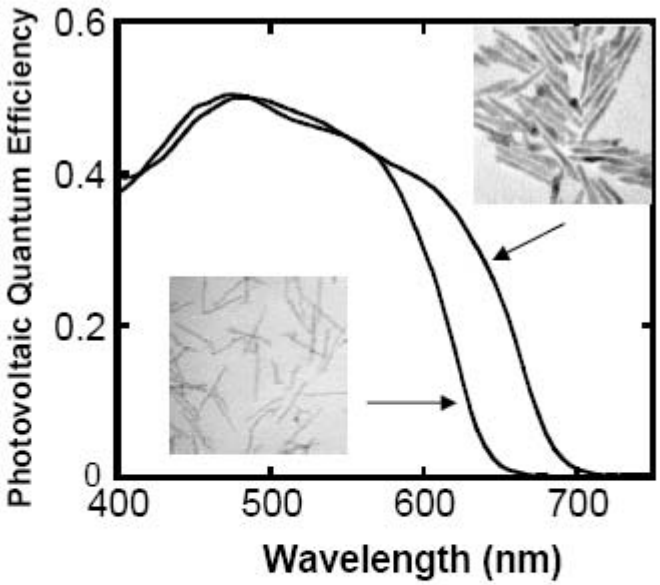


Exploiting RAMP for Energy Sources

- Photovoltaic Materials Improved Performance by 3X
- Tandem cells can be fabricated from different diameter nanorods; each absorbing a different wavelength



Separately converting light of different wavelengths in different layers enhances overall conversion efficiency

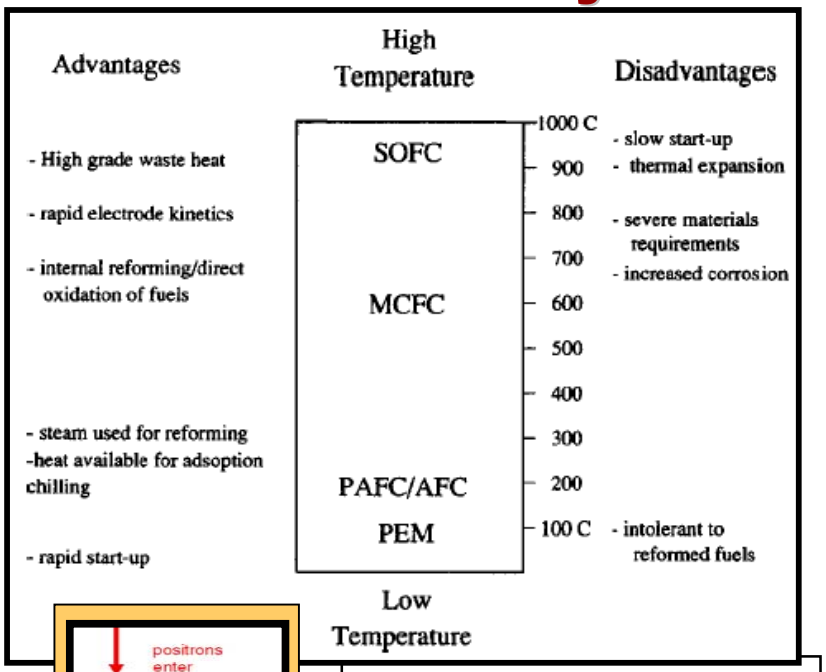


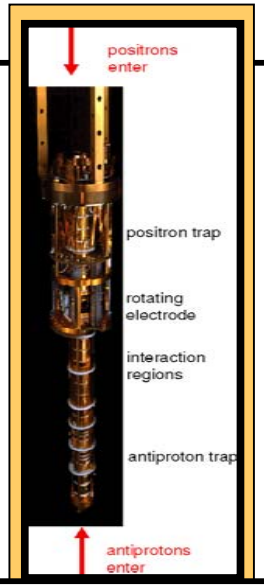
Photovoltaic spectral response changes as a function of nanorod diameter

Optimized nanocomposite tandem cells will covert solar power with efficiency greater than 50%

Exploiting RAMP for New & Extreme Density Energy Sources

- Fuel Cells
  - Solid Oxide
  - Proton Exchange Membrane (PEM)
  - Phosphoric Acid
  - Molten-Carbonate
  - Alkaline
  - – Bypass limits of Carnot Cycle ~ 20% Gasoline, 30-35% Diesel
  - – Fuel Cells theoretical 90% efficiency, @ 50% in practice:
  - – Reduce power generation sustainment costs by 50%
- Extreme High Density Energy Sources
  - – Anti-Matter ~ Decade of practical research
    - Supports High-Energy Weapons ~ Mega-Joules per Shot
    - Breaks Dependency on Hydrocarbon- Based Energy Sources
  - – Nuclear Fusion ~ still theoretical ~ Extensive Research





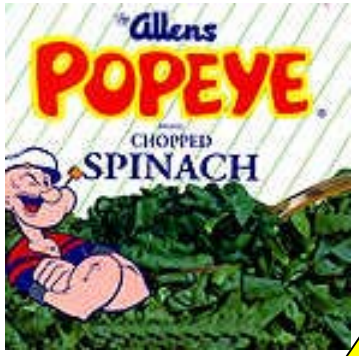
Antimatter Production Equipment Used at Harvard University

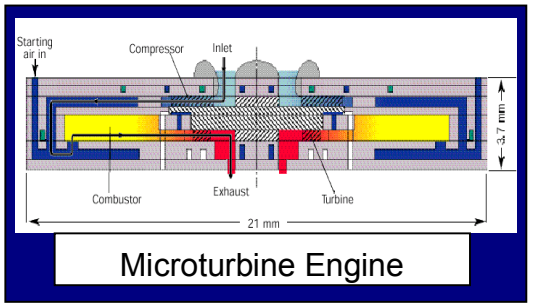
Revolutionary microscale fuel processor, which consolidates several chemical processes and operations into one package, is considered the world's smallest integrated catalytic fuel reformer

Exploiting RAMP for New & Extreme Density Energy Sources

- Biomass from the seas
  - Extracted using spinach proteins
- Engines
  - Micro-Turbine ~ 100 times equivalent of current batteries for soldiers
  - Sterling ~ 10 yrs @ 60Kw unrefueled
- Next Generation Photovoltaic Material
  - Produce energy in quantities sufficient to power:
    - climatic control equipment,
    - embedded prognostics, and
    - autonomous communications equipment

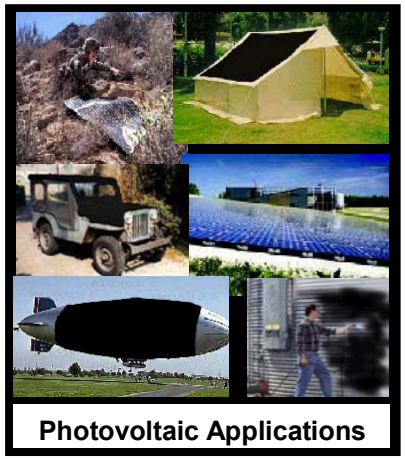
  without the requirement to refuel generator engines or replace batteries





Microturbine Engine

Elimination of Batteries & Hydrocarbon-Based Fuels


Photovoltaic Applications

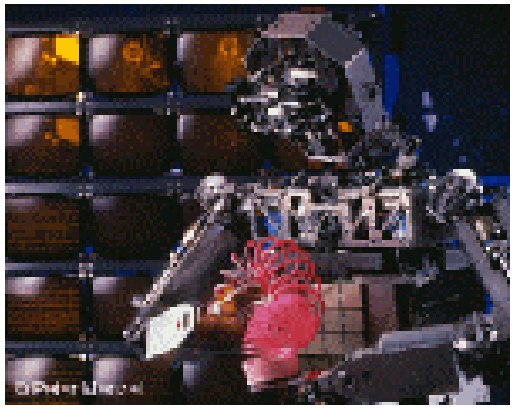
	Efficiency	Cost	Flexibility	Weight	Stability	Maturity
Thin film	Medium efficiency	High cost	Rigid	Heavy	High stability	Medium stage
Crystalline Si	Medium efficiency	High cost	Rigid	Heavy	High stability	Late stage
Amorphous Si	Low efficiency	Medium cost	Moderate flexibility	Heavy	High stability	Late stage
Graetzel	Medium efficiency	Low cost	Rigid	Moderate	Low stability	Medium stage
Nanocomposite Photovoltaics	High Efficiency	Low Cost	Highly Flexible	Light Weight	High Stability	Early Stage

Photovoltaic Technologies Comparison

Exploiting RAMP Provided Materials, Cognitive Capabilities to Achieve Humanoid Robots

Robotic hand (Photographed at JPL)
Courtesy of Dr. Graham Whiteley, Sheffield Hallam U., UK.

The humanoid robot Cog

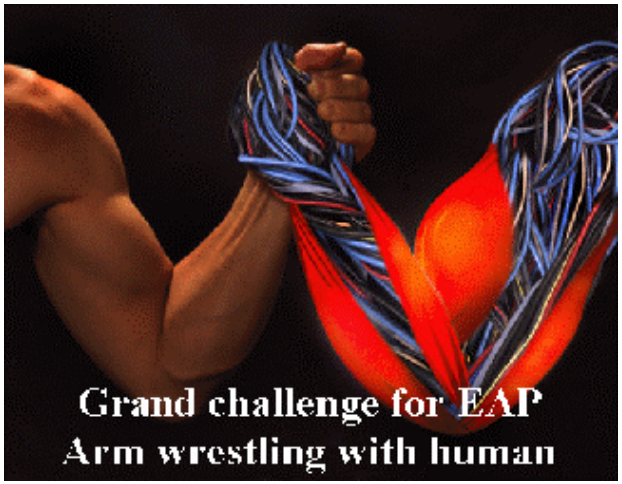


Platforms for EAP demonstration

Android facial expressions (photographed at JPL)
Courtesy of David Hanson, U. of Texas at Dallas

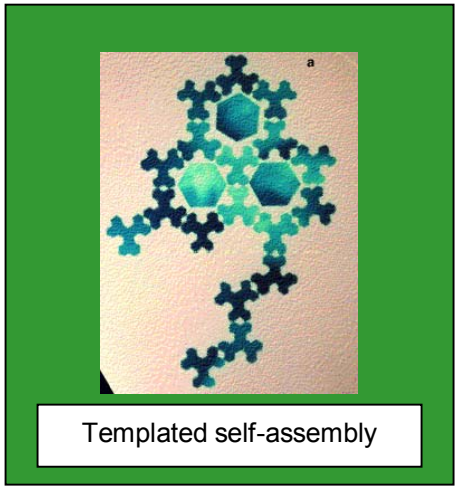
Electroactive Polymers (EAP)
The Muscles in Humanoid Robots

- **The most attractive feature of EAPs is their ability to emulate biological muscles with:**
  - High toughness
  - Large actuation strain
  - Inherent vibration dampening
- **Offers the potential for developing biologically inspired robots with:**
  - Greater agility
  - More dexterity
  - Increased lifting capacity

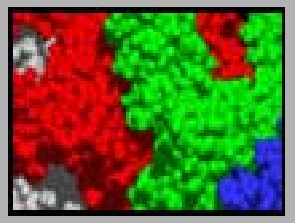


Manufacturing Designer Materials (Metamaterial)

- **New Manufacturing Processes**
  - **Self Assembly exploits natures "manufacturing" processes**
    - **Knowledge of forces holding Atoms and Molecules together**
    - **Biological processes of molecular self-assembly ~ *MSA***
    - ***Design Materials with the Perfect Properties***
      - *Strength*
      - *Non-corrosive*
      - *Impedence etc*

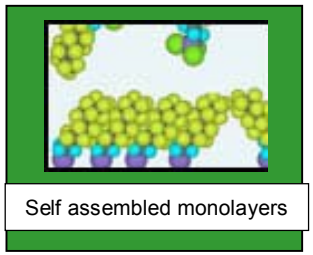


- **Molecular Replication**
  - **Self-assembly, self-organizing processes**
  - **Think of it as placing bricks in a wall**
    - **In an automated fashion where**
    - **Every brick is "perfect" and**
    - **Every brick is "perfectly" aligned**
    - **All mortar is "perfectly" mixed and placed**



Molecular chaperones are cellular proteins that assist other proteins in the folding and assembly of higher order structures without being components of these final structures.

- **Point of Consumption Manufacturing**
  - **Foods and Medicines**
    - **Reduce demands on limited strategic lift assets**
    - **Reduce requirement for battlefield distribution**



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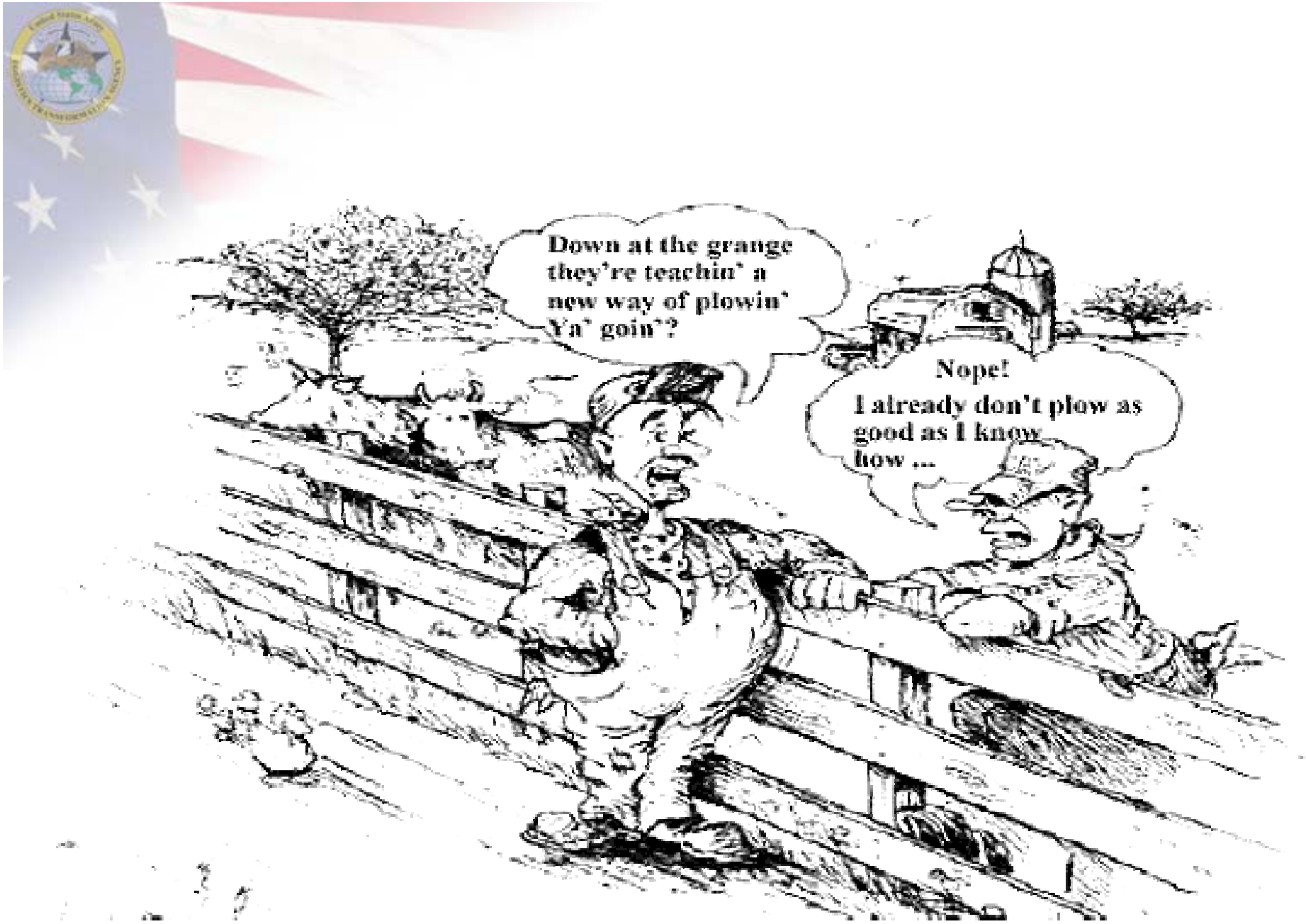

Down at the grange they're teachin' a new way of plowin' Ya' goin'?
Nope!
I already don't plow as good as I know how ...

Sense and Respond Logistics Concept

Mass-Based

- More is better
- Mountains of stuff measured in days of supply
- Uses massive inventory to hedge against uncertainty in demand and supply
- Mass begets mass and slows everything down

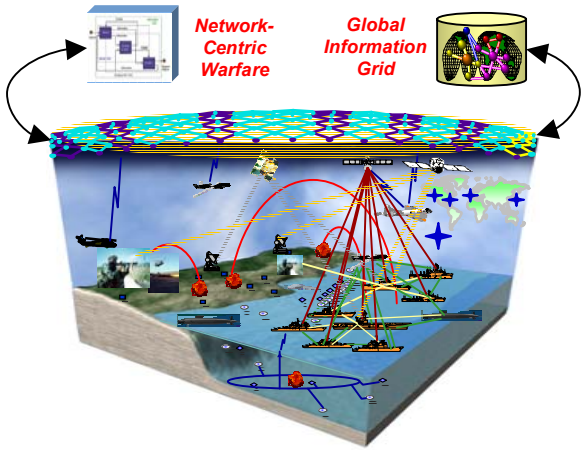
Prime Metric: Days of Supply

Distribution-Based

- On-time is better
- Inventory is reduced to a minimum and kept moving
- Uses precise demand prediction and static optimization to purge uncertainty
- Works great, except when it doesn't

Prime Metric: Customer Wait Time

Sense & Respond



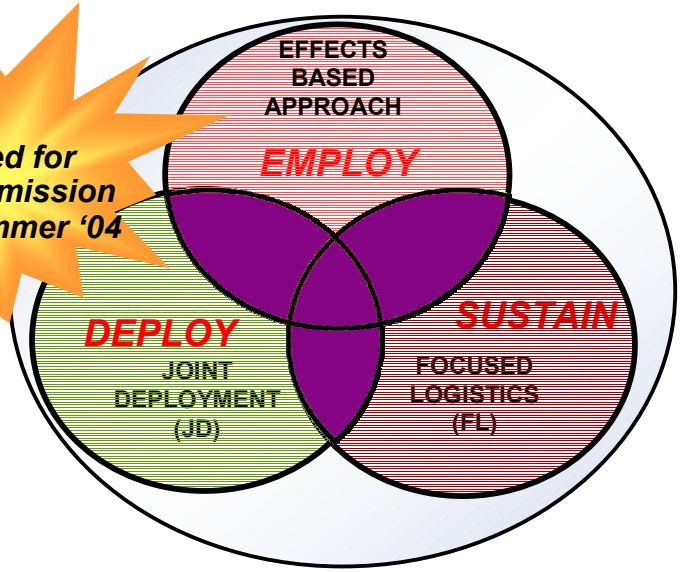
- Adaptive is better
- Inventory is dynamically positioned throughout
- Uses transportation flexibility and robust IT to handle uncertainty
- Initial S&R models look promising
- Supports distributed, adaptive ops

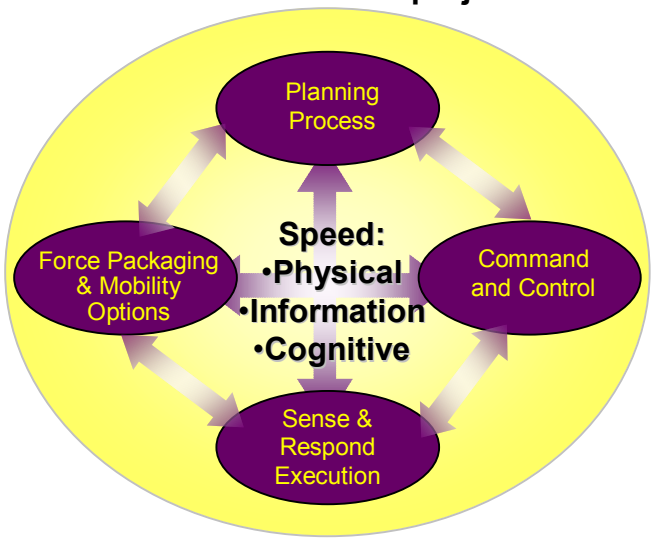
Prime Metric: Speed/Quality of Effects

Joint Integrating Concept: Joint Deployment, Employment, and Sustainment

- **Central Theme:**
  - Integrate force projection and support operations into a single coherent system; anticipate, through sensing and interpreting the environment, and then respond through networked capabilities; focus on precision from the point of effect to the source of support—all to enable fully adaptive military employment options
- **What this *integrating* concept addresses:**
  - Merger of force projection and support operations to support employment
  - Employment of an effects based approach
  - Planning operationally from end to end
  - Capabilities rather than commodities
  - Structural change at all levels, vertically and horizontally
  - Reduction in force projection and support demands

Projected for JROC Submission Spring/Summer '04





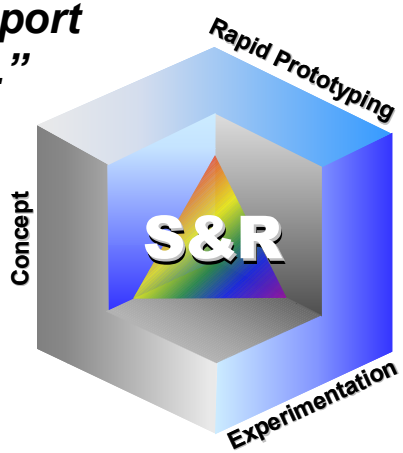
From:
- *Overwhelming Force*
- *Deconflicted*
- *More Sequential*
- *More Contiguous*
- *Joint at the Operational Level*

To:
- *Overmatching Power*
- *Coherent*
- *More Simultaneity*
- *More Noncontiguous*
- *Joint at the Point of Action*

"The sense and respond joint deployment and sustainment system focuses on speed and quality of effects."
USJFCOM Concept Paper, Apr 04

Sense and Respond Logistics

"…an end-to-end, point-of-effect to source-of-support network of logistics resources and capabilities."



- ***What This Really Means Is This:***
  - A capabilities multiplier for operational forces.
  - Increased range of support options.
  - Synchronizes options with operational effects.
  - Anticipates support problems.
  - Identifies potential constraints earlier.
  - Responds to changes in operational tasks.
- ***Embedded Capabilities***
  - Real-time control
  - Intelligent Agents
  - Predictive modeling
  - Dynamic Optimization
  - Risk Management
  - Knowledge Management
- ***Scope encompasses how we fight, how we do business, and how we work with others.***

So What Changes?

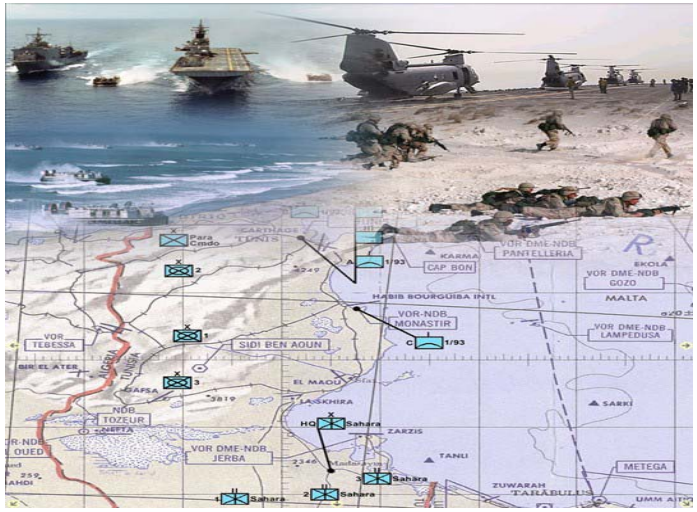
- ***Traditional***
  - Linear
  - Service Stovepipes
  - Functional Stovepipes
  - Title Ten-Driven
  - Pre-Planned
  - Hierarchical
  - Not Flexible
  - Consumption-Based
  - Brittle, Rigid Supply Chains

- ***Sense and Respond***
  - Non-linear
  - Cross-Service Mutual Support
  - Cross-Enterprise
  - Joint Logistics
  - Continuous Planning, Execution
  - Networked
  - Flexible
  - Adaptive, Cognitive
  - Flexible Demand Networks

What Capabilities Does Sense and Respond Bring to JDES?

A principle that underwrites JDES is a "…sense and respond joint deployment and sustainment system that focuses on speed and quality of effects."

- **Real-time logistics management and control**
- **Adaptive logistics between battlespace entities and the support network in a Joint/Coalition Expeditionary/Adaptive Warfare context**
- **Dynamic, continuous, integrated logistics planning**
- **Flexible basing and forward provisioning, including sea-basing**
- **Integration of logistics functions with operations and intelligence functions, providing proactive support to command decision-making**
- **Integration of CONUS, OCONUS, host-nation, indigenous, and allied logistic resources**



Leverages commercial sector success with adaptive supply chain technologies.

Transformation Challenges

Commercial Sector has made great strides in adaptive enterprises, but the challenges the military faces are different…

- Non-linear, distributed, non-contiguous operations
- Increasing emphasis on simultaneity
- Full spectrum operations within same theater
- Joint, Interagency and Multi-national (JIM) all the time
- Entire Logistic Pipeline will be a target for attack
- Rapidly reorganizing structure

Real-Time, Effects-Driven Demand and Support Networks

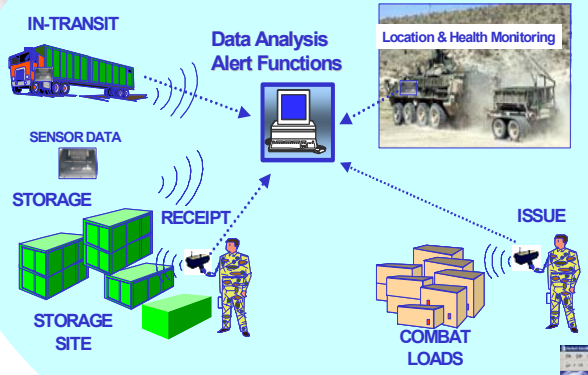
Yet Our Strategy Must Embrace…….

- ***A New Framework***
  - *New technology context*
  - *Broadened threat context*
  - *New strategic context*
- ***Joint Attributes***
  - *Fully Integrated*
  - *Expeditionary*
  - *Networked*
  - *Decentralized*
  - *Adaptable*
  - *Decision superiority*
  - *Increasingly lethal*

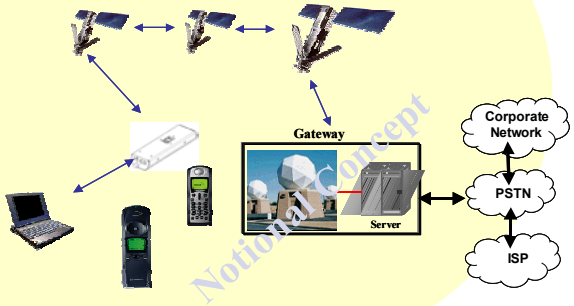
- *Knowledge Based Environment*
- *Cross-Service*
- *Cross-Organizational*
- *Dynamically-Managed Inventory*
- *Rapid Configuration*
- *Rapid Reconfiguration*
- *Transparency, transportation flexibility, and robust IT to leverage uncertainty and manage risk*

Examples of Applications & Technologies

Micro Electro-Mechanical Systems

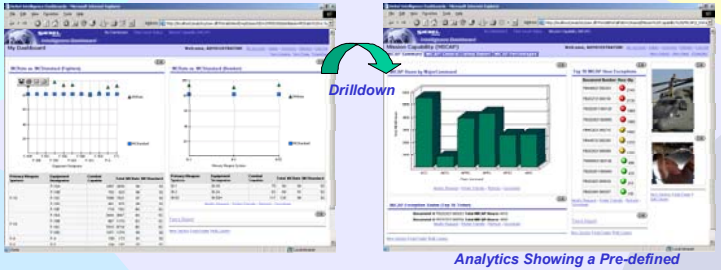


Radio Frequency Identification (Active/Passive)



Sense and Respond Logistics

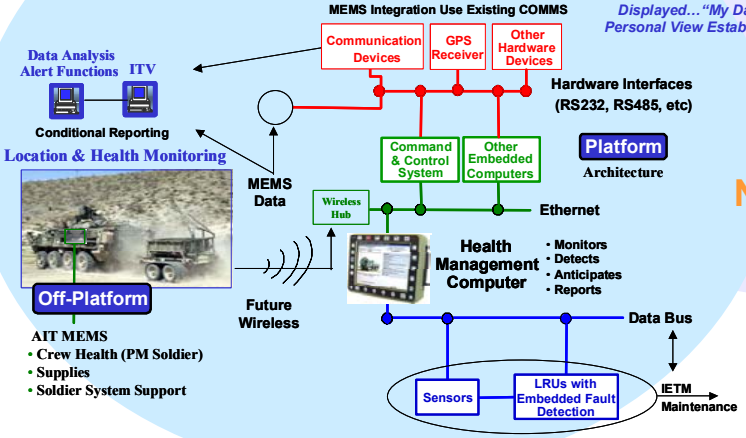
Dynamic Analytic Dashboard Via User Desktop



Dashboard With Reports and Charts Displayed…"My Dashboard" Is the Personal View Established by the User

Analytics Showing a Pre-defined Dashboard This View Shows Bar Charts, Icons That Change Color Based on the Data Value and a Rolling Ticker of the Current Data Values.

Common Logistics Operating Environment



Net-Centric Logistics with Intelligent Agents

Integrated Logistics Aerial Resupply

G-4 Focus Areas

- "CONNECT" OUR LOGISTICIANS
  - Agile, Assured, 24 / 7 Data Capability into the Enterprise
  - Plug / Un-plug as Required
  - Enable "Sense and Respond" Logistics
  - Include Log, Per, Med & Eng
    - (Operational Sustainment)
- MODERNIZE THEATER DISTRIBUTION
  - Single Proponent
  - Enable Control With 100% Visibility
  - Single Doctrine, Force Structure & Training
  - Speed and Precision
- IMPROVE FORCE RECEPTION
  - APOD / SPOD; Distribution; Life Support
  - Strategic Connectivity - Theater Log C2 Node
  - Embedded Sustainment Capability
  - Life Support – Division in 5 Days
- INTEGRATE THE SUPPLY CHAIN
  - Single Proponent
  - Eliminate Stovepipe Suboptimization

FIX THE CURRENT FORCE

- CRITICAL TO SUCCESS
  - Our Commitment
  - Joint Integration
  - Policy Modernization
  - Refined Doctrine
  - New Force Structure
  - Standards and Discipline

Challenges

Transformation Challenges

- **We Must Lead Change**
  (Historically, we have been led by change)
- **The pace of technological advancement is increasing, yet our ability to adapt remains static…**
- **Technological advancement is a double-edged sword**
- **Large institutions resist change**
- **Our culture must swiftly embrace Transformation as a way of doing business**
- **Individuals Change Organizations**
- **Organizations Change Institutions**

Final Thoughts

- Change is inevitable and occurring faster than ever before and at an ever increasing rate
- To survive, organizations must embrace and internalize change in their cultures.
- The most successful survivors will be those who are most agile, receptive, adaptive and responsive.
- The leaders among the successful survivors will be those who foresee and prepare for change, and act decisively to exploit their brief technological advantage.


SUSTAINING THE TRANSFORMING ARMY-
WHILE
TRANSFORMING THE SUSTAINING ARMY
We Can't Do It Without YOU!